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Volvariella cubensis: a rare neotropical agaric new to South America

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Abstract — *Volvariella cubensis* (*Pluteaceae*), a relatively rare species, is reported from South America for the first time. A discussion of the occurrence of acrophysalides in *Agaricales* and their phylogenetic implications is also provided.

Key words — *Amanitaceae*, *Amanita*, *Limacella*, *Pluteus*, *Squamanita*, *Russula*

Introduction

Volvariella Speg., which belongs to the *Pluteaceae* Kotl. & Pouzar (*Agaricales*, *Basidiomycota*), is easily recognised by its pink spore print, presence of a saccate volva at the stipe base, and the bilateral, inverse lamella trama (Singer 1986). In addition, the presence of acrophysalides in the stipe context was reported in *Volvariella* (Reijnders 1993).

The earliest records of this genus in Brazil were given by Rick (1961, summarizing 1907, 1919, 1920, 1924, and 1938), who cited ten taxa, all from Rio Grande do Sul State. Singer (1953, 1989), Bononi et al. (1981), Grandi et al. (1984), Pegler (1997), de Meijer (2001, 2006), Sobestiansky (2005), and Menolli-Junior & Capelari (2008) reported additional species of this genus from various Brazilian States. In Northeast Brazil, Batista (1957) recorded *Volvaria oswaldoi* Bat. and *V. speciosa* (Fr.) P. Kumm. The first name was later recombined as *Volvariella oswaldoi* (Bat.) Putzke (Putzke 1994, as "*osvaldoi*"). *Volvariella cnemidophora* (Mont.) Singer was cited by Batista & Bezerra (1960) from Northeast Brazil. The last species and *Volvaria speciosa* are synonyms of *V. gloiocephala* (DC.) Boekhout & Enderle, according to Boekhout & Enderle (1986).

In this work, *Volvariella cubensis* is described and illustrated from the northeastern Brazilian State of Pernambuco. The presence or absence of acrophysalides in the tissue of some agaric genera, a neglected anatomical topic first raised by Reijnders (1993), is also discussed.

Material and methods

Fresh material was collected and the usual methodology on the study of agaric fungi was followed. For the identification of the species Shaffer (1957) and Pegler (1983, 1988) were used. Presentation of basidiospore data follows the methodology proposed by Tulloss et al. (1992) as summarized by Tulloss & Lindgren (2005), slightly modified. At the beginning of a set of spore data, the notation "[*a*/*b*/*c*]" is to be read "*a* spores were measured from *b* basidiomata taken from *c* collections." A summary of definitions of biometric variables follows:

L (**W**) = average length (width) of the basidiospores measured from a single basidiome;
Q = the ratio of length to width of a basidiospore or the range of such ratios for all basidiospores measured;
Q = the average of all Q values computed for all basidiospores measured from a single basidiome.

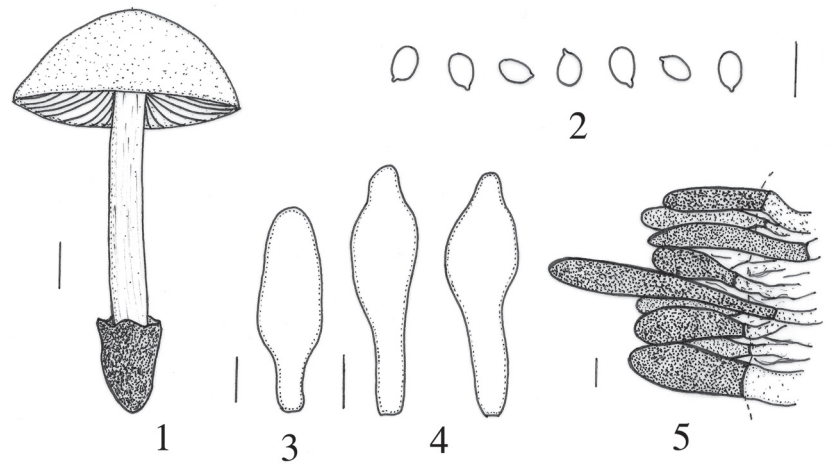
The specimen was deposited in URM (Herbarium of the Department of Mycology of the Universidade Federal de Pernambuco, Brazil).

Taxonomy

Volvariella cubensis (Murrill) Shaffer, Mycologia 49: 564. 1957. Figs. 1–5

Pileus up to 50 mm wide, campanulate then broadly convex, not fully expanding; surface grayish brown, slightly paler at margin, with minute dark fibrils, margin entire, not striate; context fleshy, up to 3 mm thick over stipe, probably white, unchanging. Lamellae free, crowded, cream at first, pinkish-brown at maturity, with lamellulae present. Stipe 68 × 9 mm, central, cylindric, solid, smooth and glabrous, cream. Volva saccate, thick, subcoriaceus, 3-lobed, grayish brown.

Basidiospores [20/1/1] 6.2–7.5(–8.4) × 4–5 µm, (**L** = 6.9 µm, **W** = 4.5 µm, Q = 1.48–1.64(–1.68), **Q** = 1.54), ellipsoid to elongate, only occasionally subovoid, smooth, with slightly thickened wall, hyaline, pinkish brown in mass. Basidia not observed, probably collapsed. Pleurocystidia difficult to observe, up to 32 × 11 µm, clavate subfusoid, thin-walled, hyaline. Cheilocystidia 28–49 × 10–15 µm, fusoid then fusoid-ventricose, thin-walled, hyaline. Pileipellis as repent trichoderm ranging up to 190 µm thick, comprising ascendant parallel non gelatinous, cylindrical hyphae up to 5 µm wide, mixed with 45–127 × 11–25 µm, cylindrical to fusoid inflated elements, having dark brown vacuolar pigment. Lamellar trama bilateral inverse. Stipe context with infrequent inflated terminal hyphal segments (e.g. 150 × 15–30 µm). Volva with 3–10 µm wide filamentous hyphae in limb and with outer surface covered by, 30–120 × 10–22 µm, clavate to cylindrical cells, brownish colored and arising from the volval tissue, slightly gelatinized. Clamp connections absent from all tissues.



Figures 1-5. *Volvariella cubensis.*
1. Habit. 2. Basidiospores. 3. Pleurocystidia. 4. Cheilocystidia. 5. Covering of volva.
Scale bar is 10 mm for basidiome and 10 µm for microstructures.

Habitat: Solitary on rotten wood in degraded part of fallen log [*Clitoria* sp. (*Papilionaceaea*)] in urban area.

Material examined: BRAZIL. Pernambuco, Recife, Universidade Federal de Pernambuco near to CCS ("Centro de Ciências da Saúde") Building, 10.vii.2003, J. Putzke & F. Wartchow s.n. (URM 78876).

Remarks: This species with a medium size basidiome is characterised by the dark greyish brown and minutely fibrillose pileus, thick volva and the size and shape of the basidiospores—6.2–8.6 × 4.3–5.3 µm, **L** = 7–7.6 µm, **W** = 4.6–4.8 µm, Q = 1.35–1.88, **Q** = 1.46–1.67, according to Shaffer (1957). It is noted that the Brazilian collection was growing on wood, whereas *Volvariella cubensis* was originally described from soil (Murrill 1911).

Volvariella bakeri (Murrill) Shaffer, with a paler pileus ranging up to 100 mm wide, basidiospores 6.9–9.3 × 4.6–6.9 µm, **L** = 7.9–8.2 and **W** = 5.1–5.7 µm, and *V. volvacea* (Bull.) Singer with 50–100 mm wide, virgate pileus; membranous volva; and basidiospores 6.9–10.4 × 4.6–7 µm, **L** = 8.4–9.1 µm and **W** = 5.4–5.8 µm, are separated from *V. cubensis* (Shaffer 1957). Pegler (1987) stated that *V. bakeri* and *V. volvacea* are very similar species, of which the first differs only in the lignicolous habit. The other dark coloured species that occurs in Brazil, *V. pusilla* var. *taylorii* (Berk.) Boekhout is easily differentiated by the small and slender basidiome and the thin, membranous volva (Pegler 1997).

Volvariella cubensis is a neotropical species originally described from Cuba (Murrill 1911, as *Volvariopsis cubensis*). Pegler (1983) cited it from Guadeloupe

reporting smaller spores 4.5–6 × 3–4 µm, **L** = 5.3 µm and **W** = 3.5 µm but indicating a thick volva for the collection that is typical of this species. The present taxon is now added to 16 taxa of *Volvariella* previously known from Brazil (Putzke & Wartchow 2008).

An interesting anatomical feature can be noted in the saccate volva of the present species. Long cystidioid bodies arise from the volval limb, which comprises plentiful filamentous hyphae. In *V. cubensis* the author observed the cystidioid bodies in the volva as being very similar to cells seen in the pileipellis. Courtecuisse (1991), on the other hand, analyzed anatomically the volval tissues of two neotropical species but found only filamentous hyphae in them. The presence of these cystidioid bodies in two tissues that are adjacent during basidiome development suggests a common (possibly hormonal) cause for their presence in the tissues.

In examining the stipe tissue of the recent Brazilian collection of *V. cubensis*, a slightly inflated cell that had a certain resemblance to an acrophysalide was noted in one section. Acrophysalides (Bas 1975) are clavate terminal cells extending from a diffuse system of usually narrow, branching hyphae in the stipe and pileus context, a tissue that is characteristic of the stipe context within *Amanita* Pers. and *Limacella* Earle (Bas 1969). In the stipe tissues of these taxa, the acrophysalides are longitudinally oriented.

Reijnders (1993) reported the presence of inflated cells in the stipe or pileus context in several agaric genera, e.g., in *Russula* Pers., *Squamanita* Imbach, *Pluteus* Fr. (*P. granulatus* Bres., see Reijnders 1993: 262, fig. 16–17) and *Volvariella*. With regard to the diversity of genera that bear acrophysalides, Reijnders (1993: 261) concluded that "the acrophysalidic trama is merely a more conspicuous expression of a feature common in the *Agaricales*." This statement deserves review based on current evidence.

Squamanita is a mycoparasitic genus (Bas 1965), and *Amanita* is one of the taxa parasitized by it (Redhead et al. 1994, Bas & Thoen 1998, Bas & Tulloss unpub. data on European and Asian collections), and there is no evidence that the acrophysalides supposedly belonging to *Squamanita* are really from *Squamanita* tissue. The "protocarpic tubers" (= cecidiocarps, according to Bas & Thoen 1998), where the acrophysalides were previously found (e.g. Singer & Clémençon 1972, as "primordial bulbs") does not belong to the *Squamanita* basidiome; they are galls provoked by infection of the basidiome of another agaric (Redhead et al. 1994) and believed to belong to the *Amanita* "host" of that parasite. Tulloss (pers. corresp.) also proposes that the hypothesis that the sphaerocysts of the *Russulales* are related in some way to the acrophysalides of *Amanita* is unproven (as also previously concluded by Reijnders 1977: 356) and does not account for the radically different ontogenies of the two fungal groups involved—*Amanita* is the only genus known to exhibit schizohymenial

development (see also Bas 1969)—or molecular phylogenetic studies of the last decade.

Recent molecular studies include *Pluteaceae* and *Amanitaceae* as possible sister taxa in a single clade, although with very weak support (Matheny et al. 2006). Although some authors may interpret this placement as somewhat justifying Reijnder's theory that *Pluteus* and *Volvariella* both have acrophysalidic stipe tissue, there is really no sound argument for deriving such a position from currently available molecular evidence. Moreover, recent anatomical analyses of stipe tissues from representatives of two neotropical *Volvariella* species have not produced evidence of inflated elements (Courtecuisse 1991). It is necessary to exercise caution before affirming the existence of acrophysalides in stipe tissue within the *Pluteaceae* s. str. Only a careful anatomical revision of a well-chosen sample of species will confirm whether or not true acrophysalides exist in *Pluteus* and *Volvariella*.

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